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BIRDS WARN PILOTS, (U)

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# FOREIGN TECHNOLOGY DIVISION



BIRDS WARN PILOTS

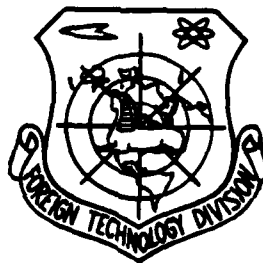
by

Radolyub Matovic

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## EDITED TRANSLATION

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PREPARED BY:

TRANSLATION DIVISION  
FOREIGN TECHNOLOGY DIVISION  
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Research in Avio-physiology

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It is no secret that special overpressurized outfits, which are worn by fighter airplane pilots in all of the developed air forces in the world, actually represent a secret of its own kind. We are referring, here, to equipment which, under conditions of cabin decompression in an airplane is intended to eliminate the negative effects of the new biological environment - hypoxia. Hypoxia is an ailment of decompression and extreme cold. The "creators" of the special pilot equipment-outfit do not even hesitate to collide with medical ethics (here in relation primarily to health protection), since just a nuance of difference in the quality of the outfit can frequently mean a huge advantage during air combat in which participate fighter pilots.

Medical institutes of all more developed air forces pay great attention to the research of special pilot equipment. Only a few types of such outfits are now being produced, mainly on account of high costs. One such complete outfit including helmet and the overpressurized suit, costs several thousands of dollars. Research relating to this kind of equipment is now being conducted even more intensively, and is covered by a veil of highest secrecy.

### Shield According to the Sword

Pioneers of the air, such as the brothers Orville and Wilbur Wright and our own Eduard Rusyan, were satisfied with simple windglasses which were just plain eyeglasses of larger size with a leather flip to protect them from the wind which was in open cabins at their time. Fighter airplanes were used en masse during WWI but their speed was low, and their flying altitudes and maneuvers did not represent any particular problems for physicians and airplane constructors in the search for better flying protection.

Already in the nineteen-twenties when aircraft had to fly "to the very roof of the troposphere", pilots were beginning to suffer during test flights from the very low pressures and cold.

The new natural environment forced general Helden to propose the use of overpressurized outfits which would be "airproof and similar to the equipment of water divers, and which can stand the pressure of about 130 mm mercury". A young American, Marc Reed, a balloonist, was the first who had shown an interest in the realization of Helden's idea. But it was difficult to obtain a permission to fly at high altitudes in modified diving equipment. It was only by the end of 1933 that such a vestment which was supplied with breathing facilities was completed. After his arrival to England, Reed had started a program of research. He himself was decompressed in a barochamber to a pressure of only 17 mm Hg, which corresponds to the air pressure at an altitude of 25,603 meters (almost 77,000 feet).

## WHY BIRDS

Since some animals are being used everywhere for tests today, Dr. Krstic has decided to use "test" birds in his experiments. Several factors influenced him: birds are the only natural fliers and it is logical that if during the flight the harmful factors reach beyond the extreme physiological limit, in other words if an artery wall of a bird is damaged by hypoxia, the same would happen to a human artery.

Birds were studied by some famous physicians: Alex Romero (1972 - factors of embryogenetic development), then Bendit (1977 - nutrition change), while Dr. Krstic's research work on the conditions of harmful factors in flying, hypoxia and acceleration, represents a contribution of our experts in the field of aeronautical medicine.

Dr. Nikola Krstic is now preparing a report on "Histological changes in the artery walls of birds after barometric depression and acceleration", which will be submitted at the XXVII International Congress of Aviation in, Manila, Pihippines, in October this year.

Very successful experiments increased the interest among aviation experts. Soon, avio-physiologists began to study flying conditions at high altitudes. In England overpressurized outfits were now introduced as standard equipment. In 1939, pilot Swayne flew at an altitude of 15,000 meters (about 45,000 feet). Already the next year pilot Adam used an improved version of the outfit and even succeeded in "climbing" to 16,400 meters (almost 50,000 feet).

These were, in short, pioneering achievements in the development of special pilot equipment for flying and for the execution of combat tasks at altitudes above 12,000 meters (<sup>almost</sup> 36,000 feet). In the 3rd millenium before our era, the Sumerians introduced shields. Two millenia later Egyptians were making shields in the natural size of man. In the similar manner this special combat shield for pilots has also been modified. World War II has speeded up improvements of pilot equipment in several European countries. The advantages of the thus equiped pilots have been quickly proven. English reconaissance pilots, equiped by a breathing vest operated at hyperpressures, were fulfilling their combat assignments in fighter airplanes in unpressurized cabins. They had achieved remarkable advantages compared to German pilots in JU-86 which did not use the overpressure.

American pilots had also gained marked advantage compared to Japanese pilots in air fights in the Pacific theater, thanks to improved anti-g outfits. Hence, already during WWII, and especially immediately after its termination, the search for materials which will be the best, was intensified. In a great number of countries equipment was developed which had been manufactured of metal, but its weight and clumsiness appeared as great drawbacks. Also, putting on such equipment before the combat missions was taking too much time. The water and air proof fabric was much more efficient. So, the best outfits are, today, generally made of an airproof inside layer, and an outside non-extendable layer which prevents excessive expanding of the body while inflating. Nevertheless, different combinations are being tested and the main evaluation criterion is that, in addition to meeting all biological

### PROOF FOR PILOTS

- Cooperation between physicians and pilots is particularly successful. "Our pilots follow preventive measures very dutifully when executing their combat tasks", pointed out Dr. Krstic. "The results which we obtained through experiments with birds, will make us even more convincing in our arguing: that the only flight which is safe is one in which all rules are strictly followed. Thus, a real gain from our experiments is that pilots, during their physiological training, became convinced in the unconditional necessity of behaving in accordance with set norms and in using their flying equipment properly. They will, thus conclude their flying career in full and good health."

requirements, the pilot would be enabled to handle airplane more precisely, easily and safely. as well as conducting air combat under conditions of a decompressed cabin. The moment, when, during the flight the decompression occurs is exactly the time when the protective pilot equipment is automatically activated.

### Research Work of Our Avio-physiologists

Flying equipment is a standard part of the equipment and armament of modern airplanes. Our pilots also utilize the most modern outfits. Our industry did not manufacture special overpressure equipment, but the physicians of our Air Force's Aviation Medical Institute of RV an PVO, for the last three decades have been intensively studying the effects of flying at high altitudes and the utilization of equipment. They have in this way given an important contribution to the development of scientific thought in avio-physiology. This is also true in regard to the improvements



Results of Dr. Krstic's tests have brought an important contribution to military scientific thought



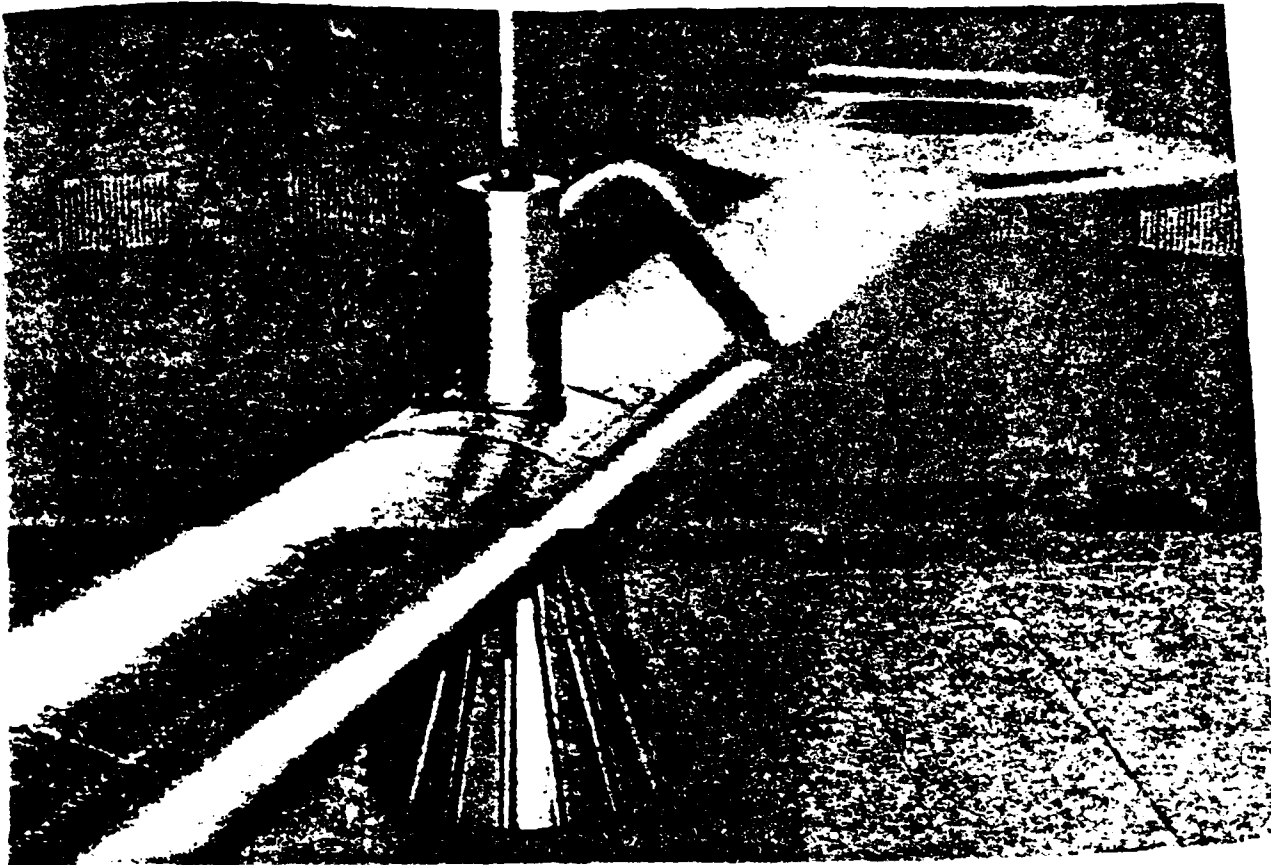
Dr. Nikola Krstic, Colonel, Magister of Avio-physiology, frequently puts on the overpressurized outfit himself, the same as used by our pilots in order to check it in experiments conducted in baro-chamber.



in the medical safety of pilots which is being achieved through physiological training and the participation of physicians in flying tests. This contributes to the protection of pilots from harmful factors inherent to flying, and also increases the control, as well as the safety of non-flying personnel. Also, an intensive work on the research is going on. A team of avio-physiologists, under the guidance of Dr. Nikola Krstic, use in their research special installations such as baro-chamber and centrifuges. They have, thus, markedly enriched our avio-medicine.

Dr. Krstic points out that, due to very well laid foundations of this scientific discipline, he was able to fully dedicate his specific research on harmful factors at flight which are related to the psychological profile of the pilots, their health and their safety when flying. In other words, the team of experts led by Dr. Krstic has directed its efforts to find out data and values which represent the borderline of safety in functioning of individual organs, blood circulation, breathing, brain, heart, etc. In addition, they strove to find out which are the limits beyond which disorders appear in the organism; furthermore how to normalize the functions which were disturbed in a short time, in order to avoid lasting adverse consequences. This is, as avio-physiologists say, the search for the extreme physiological limits.

While investigating harmful flight factors related to animals, our avio-physiologists have arrived at valuable conclusions. During the last ten years blood circulation in the brain has been very intensively investigated. Ironically, while the brain is the least



Counteracting the effects of centrifugal force, our pilots exercise in a centrifuge of the VMI. One part of centrifuge's leg and gondola are visible in the picture above.



Before each flight or centrifuge tests, the birds are medically examined. During experiments the reactions of their organisms are recorded and studied.



understood, is really the most important for flying. By introducing the painless methods into research related to men - as initiated by Docent Dr. Alexandar Radovic, Colonel - the physicians and flyers understanding was broadened. The same is the case with diagnosing of brain blood circulation situations. Changes in artery walls were discovered taking place when the overloads surpassed the extreme physiological limits.

Successful scientific results have stimulated Dr. Krstic and his colleagues to study these phenomena daily. This research also included birds, the only genuine flyers. According to results obtained in the baro-chamber and centrifuge, the avio-physiologists of the VMI RV and PVO, are ready to prove that hypoxia of the cells in the artery's walls brings about serious disorders which disturb the integrity between two endothelial cells and allow some elements from the blood plasma (cholesterol, fats, albumen) into the arteries' deeper wall structures. Another important work was to hatch the normal chicken from eggs which were exposed to an altitude of 30,000 meters (<sup>almost</sup> 90,000 feet) at a barometric pressure of only 8.9 mm Hg. However, after a certain incubation period, the eggs hatched experimental monsters, because the extreme physiological limits were surpassed.

Here we have the scientific proofs whose messages reach far out to warn the pilots: at high altitude flights there is hypoxia, a cunning enemy and a cause of airplane disasters lurks. Hypoxia can bring about health disorders, unless all preventive measures have been undertaken. This is, without any doubt, a contribution of our experts in their attempts to discover more reliable shields for pilots and, above all, for their health.

## PREVENTION BEFORE ALL

When flying at altitudes above 12,000 meters (almost 36,000 feet), pilots use overpressure outfits, into which a certain anti-g system is also built in order to reduce the effects of the centrifugal force. Pilots also have a special helmet. This is all to protect them during flights from extremely low pressures, temperatures, speed and other harmful factors. Above an altitude of 12,000 meters (almost 36,000 feet), equipment for breathing oxygen under conditions of hyperpressure is utilized; at altitudes above 15,000 meters (almost 45,000 feet) it is indispensable to have suits which supply counterpressure.

This special outfit, in fact, is used very rarely and its primary role is preventive. At all altitudes during the execution of combat tasks, the ideal pilot protection represents an overpressurized cabin. In it temperature and pressure are maintained in normal ranges. Yet, if a rupture of the cabin occurs, or a malfunction in the system for air compression takes place - and under the combat conditions this does happen - the pilot outfit is automatically activated and the pilot is ready to continue the combat, although under more difficult conditions or personal movement. The pressure outfits which are used now guarantee an easy abandonment of the airplane, or descent with the damaged cabin, even from an altitude of 40,000 meters (120,000 feet) to which no airplane has ever climbed.

Differently from airplane pilots, cosmonauts are protected with scaphanders, in which there is a microclimate around the pilot under all conditions. For cosmonauts this is a normal biological environment. In the case of pilots, the pressure outfits are activated only when the pressurized cabin fails.

Radolyub Matovic